JOURNAL

OF THE

ELISHA MITCHELL SCIENTIFIC SOCIETY

JUNE, 1907

VOL. XXIII NO. 2

PROCEEDINGS OF THE NORTH CAROLINA ACADEMY OF SCIENCE, SIXTH ANNUAL MEETING, HELD AT CHAPEL HILL, MAY 17TH AND 18TH, 1907.

The executive committee met Friday, May 17th at 1 p. m., the following members being present: Collier Cobb, W. C. Coker, John F. Lanneau, and F. L. Stevens.

The following names were proposed for membership to the Academy and were elected to membership by the executive committee: Dr. C. H. Herty, Chapel Hill; Dr. J. H. Pratt, Chapel Hill; Dr. A. S. Wheeler, Chapel Hill; Dr. J. E. Mills, Chapel Hill; Dr. R. O. E. Davis, Chapel Hill; N. C. Curtis, Chapel Hill; J. G. Hall, West Raleigh; H. W. Smith; W. A. Withers, West Raleigh; Dr. G. A. Roberts, West Raleigh; F. P. Drane, Chapel Hill; R. T. Allen, U. S. Geological Survey; J. E. Pogue, Jr., Chapel Hill; Miss Daisy B. Allen, Raleigh; Louis W. Gaines, Wake Forest; W. N. Hutt, Raleigh; J. J. Wolfe, Durham; M. H. Stacy, Chapel Hill; Clifton D. Howe, Biltmore; C. W. MacNider, Raleigh: Will L. Brewer, Greensboro.

At 3 p. m. Friday, the 17th, the Academy was called to

Printed June 17.

order by its President, Professor Collier Cobb, and an address of welcome was extended to the Academy by President Francis P. Venable, of the University of North Carolina. A response to the address was made by the retiring President, John F. Lanneau, of the Academy of Science. The remainder of the afternoon session was devoted to the presentation of papers.

At 9 p. m. the Academy met in Gerrard Hall, and the presidential address, "The Garden, Field, and Forest of the Nation," was delivered by President Cobb. Following this address a reception was extended the visiting members in the Y. M. C. A. building.

Saturday, May 18, at 9 a. m., the Academy convened for a business meeting. The minutes of the last meeting were read and approved, and the names of the new members, as elected by the executive committee, were read and formal vote of election to membership was made.

The nominating committee, previously appointed, presented for election the following names: President, T. Gilbert Pearson; Vice-President, W. C. Coker; Secretary, F. L. Stevens; members of the executive committee, Franklin Sherman, Jr., J. J. Wolfe, and John F. Lanneau. It was moved by F. L. Stevens that the name of E. W. Gudger be substituted for that of F. L. Stevens for Secretary. The amendment was carried. These nominees were then elected to office for the ensuing year. The report of the Treasurer, showing a balance of $122.53, was received. Raymond Binford and Franklin Sherman, Jr., were appointed as auditors. It was moved and carried that the executive committee be requested to hold the meeting next year two weeks earlier than that of this year.

Following the business meeting was held a meeting for the presentation of papers.

The following papers were presented:

1. The Sparsity of the Stars, the Measureless Remoteness of

each Star from All Others, John F. Lanneau, Wake Forest College.

The paper will appear in full in Popular Astronomy.

2. The Foundations of Geometry, Archibald Henderson, of the University of North Carolina, published in The Journal of the Elisha Mitchell Society, May, 1907.

3. Some New Sources of Light, C. W. Edwards, Trinity College. Read by title.

4. Some Interesting Grasshoppers (and Their Relatives) of North Carolina, Franklin Sherman, Jr., State Entomologist.

5. Osteogenesis Imperfecta (with a report of a case), Lewis M. Gaines, of Wake Forest College. Read by title.

6. Notes on the Cultivation of Algae for Class Use, F. L. Stevens, of the North Carolina College of Agriculture and Mechanic Arts.

Suggestions were given for the isolation and cultivation of algae upon solid medium, consisting of 75 per cent. ager made up with Knopf's solution. This medium solidifying at lower than 34 degrees, can be safely used in plating out algae. Cultures of several forms were exhibited.

7. Fusion of Sponge Larvae with formation of composite sponges, H. V. Wilson, of the University of North Carolina.

The ciliated larvae of silicious sponges (Stylotella) may be made to fuse, thus giving rise to composite sponges. To accomplish this result it is only necessary to bring the larvae in close contact at the time when the ciliary action is no longer locomotary and fixation is about to occur. The composite masses representing (in the actual experiments) from two to six larvae complete the metamorphosis.

8. Wind-polished pebbles, and Palaeolithic Man, Collier Cobb, of the University of North Carolina.

The close similarity between pebbles faceted and polished by the sand-blast and the implements of early man was indicated, and the errors which might result from superficial observation were pointed out.

9. Notes on the Zoology of Lake Ellis, C. S. Brimley, Raleigh, N. C.

The paper discusses the occurrence of various insects and reptiles taken by the writer and others in the vicinity of Lake Ellis, Craven County, N. C., during June, 1905, and May, 1906. The rare salamander, Stereochilus marginatus, which had not been taken for many years, was found to be common, and several specimens of the frog, Rana virgatipes, were taken. Nine alligators were secured on the two trips by the author's companion, and several rare snakes. Five species of dragon fly, new to North Carolina, were secured, and (in June, 1905,) numerous specimens of the yellow fly (Diachlorus ferrugatus). Notes on other members of the Tabanidae are also given.

10. Single Phase Railway Work, J. E. Latta, of the University of North Carolina.

11. The Relation of the Cattle-tick to Southern Agriculture, Dr. Tait Butler, State Veterinarian, Raleigh, N. C.

12. The Design of High Masonry Dams, William Cain, of the University of North Carolina.

The method of finding the resultant of the water pressure and the weight of masonry pertaining to any horizontal joint of a dam is given; also the decomposition of the vertical component of this resultant along the joint according to the usual hypothesis. The hypothesis of the conservation of plane sections, in the case of a battered wall, is then criticised and the resulting vertical unit pressure at a face of the

wall, shown to be too high and therefore on the side of safety. But since the pressure near a face, acts necessarily parallel to that face, the vertical unit pressure just computed, is not the whole pressure.

The difficulty of computing exactly this whole pressure is next entered into and an upper limit found by an approximate method which again gives an excess pressure.

Rankine's suggestion, to use the ordinary formula for vertical unit pressure, but specify higher limiting unit pressures for the up-stream face than for the down stream face is adopted provisionally.

The claim is made that, in addition to the three universally imposed conditions, no tension, safe unit pressures and no possible sliding at any horizontal joint—a fourth condition must be imposed, viz., that the factors of safety against overturning and sliding shall increase gradually from the base upwards to allow for the proportionately greater influence, on the upper joints of wind and wave action, floating ice or other bodies, and especially of the great forces caused by the expansion of thick ice under an increase of temperature and by earthquakes.

It was found that this could easily be done by taking the well-known theoretical triangular type of cross-section of dam and making some additions at the top sufficient for a roadway.

A preliminary design is given for a dam 258 feet high, with factors of safety and unit pressures marked on the drawing, satisfying all four conditions. The area of cross-section and height being the same as for the celebrated Quaker bridge design, a comparison was instituted, unfavorable to the latter, in that its factors of safety are too small, particularly in the upper portions, where by the proposed fourth condition they should be largest.

This criticism owes its significance to the fact that the new Croton Dam of New York, 224 feet high to water surface and finished February 1st, 1906, at a cost of over $7,500,000, has

a profile for 224 feet in depth, exactly the same as the Quaker bridge design for the same depth.

Engineering News for June 30, 1888, January 12, 1893, and May 9, 1907, is referred to for the destructive action of ice on ponds, lakes, and rivers, due to the expansion from an increase of temperature during the day. At night, contraction causes cracks to form, often several inches wide, which are filled up with new ice and thus the effect, from day to day is cumulative and very destructive as far north as Canada and in the Northern States. As yet, the action of ice on high dams has not received much attention.

For earthquake action on houses, Milne is referred to; also a personal experience of the author in Charleston, S. C., is recited. It was pointed out, however, that dams being built into the sides of the valley at their ends, were not so free to move at their tops as houses.

A brief description and analysis of the failure of the Habra dam concludes the paper.

13. Three Little Known Species of North Carolina Fungi, J. G. Hall, of the North Carolina Experiment Station.

14. A New Form of Achlya, W. C. Coker, of the University of North Carolina.

During the fall of 1906 an Achlya was found at Chapel Hill, N. C., which agrees with *Achlya racemosa*, var. stelligera Cornu, in many respects, but different from it in having the autheridum cut off immediately below the oogonium, and the fertilizing tube arising from the division wall and entering the oogonium from below, as in Saprolegnia hypogyna Pringsheim. Such an origin for the fertilizing tube is new for the genus Achlya, and is not known elsewhere except in Saprolegnia hypogyna.

15. Notes upon the Preparation of the Silicate Medium for the Cultivation of Bacteria, J. C. Temple, N. C. Agricultural Experiment Station.

Directions were given for the preparation of this medium obviating the necessity of dializing, and making it possible to prepare this medium with greater certainty and greater accuracy. The use of the medium prepared in this way for the culture of various organisms was illustrated by colonies of various bacteria growing in a thriving condition upon the medium.

16. Breeding Colonies of Birds (Illustrated with Eggs and Stereopticon views), T. Gilbert Pearson, of Greensboro.

17. The Efficiency of Soil Inoculation in the Production of Root Tubercles, F. L. Stevens, of the North Carolina Agricultural Experiment Station.

Data was given concerning the inoculation of soils with liquid cultures obtained from the Department of Agriculture, Washington, D. C. From many tests conducted in various ways there was no evidence whatever that inoculation with these cultures was efficient in the production of tubercles upon the legumes. The cultures employed were issued in liquid condition in hermetically sealed test tubes, and were obtained directly from the Bureau of Plant Industry, Washington, D. C.

18. The Opportunities for Study and Research at the Beaufort Laboraty, H. V. Wilson, of the University of North Carolina.

19. Does Blood Tell? Heredity According to the Experience of the Children's Home Society, William B. Streeter, of Greensboro, N. C.

20. Geology of the Cape Fear River, Joseph E. Pogue, Jr., of the University of North Carolina.

21. The Relation of Sporangium of Lygodium to the Evolution of the Polypodiaceae, Raymond Binford, of Guilford College.

22. The Condensation of Alipatic Aldehydes with Aromatic Amines, Alvin S. Wheeler, of the North Carolina University.

The following reaction takes place without any dehydrating agent: $RCHO+2RNH_2=RCH(RNH)_2+H_2O$. In some cases at low temperatures the addition product is obtained. Condensation products of Chloral with the three nitranilines, p-bromaniline, o-toluidine, anthranilic acid, and o-anisidine were prepared. By-products, as yet unidentified, were obtained with o-toluidine and with anthranilic acid. The condensation products are readily broken down by Hydrochloric acid and by acetic anhydride. When suspended or dissolved in the glacial acetic acid they react with extreme smoothness with bromine, forming beautifully crystalline compounds which are much more stable than the condensation products.

23. Chapel Hill Ferns, by W. C. Coker, of the University of North Carolina.

A collection of the living ferns and fern allies native to Chapel Hill, N. C., was made and exhibited in pots. Twenty species were represented, including all the known Ptridophytes of the neighborhood, except Botrychium ternatum and its variety, dissectum, which had not yet appeared above ground.

24. Notes on Turtles of Genus Pseudemys, C. S. Brimley, of Raleigh, N. C.

25. Electricity in Heavy Traction (Illustrated by lantern slides), J. E. Latta, of the University of North Carolina.

26. The Optical Rotation of Volatile Oil, C. H. Herty and G. A. Johnson, of the University of North Carolina.

27. Children's Home Society Methods, William B. Streeter, of Greensboro.

28. Gametophytes of Botrychium Virginianum, Raymond Binford, of Guilford College.

They were found in moist oak woods under the leaves. Some were almost on the surface of the soil while others were imbedded one to two inches in the soil. They seem to have gotten down by means of worm holes or cracks made by roots of trees. Sizes ranging from 2 m. m. to 10 m. m. were shown. Specimens of these plants were exhibited before the Academy.

A motion of appreciation of the courtesies extended to the Academy by the members at Chapel Hill and ladies of Chapel Hill was unanimously carried.

At 1:30 o'clock Saturday the Academy adjourned.

F. L. STEVENS, Secretary.

THE GARDEN, FIELD, AND FOREST OF THE NATION.

BY COLLIER COBB.

(Address as President of the North Carolina Academy of Science.)

It has been the boast of more than one of our politicians that North Carolina could well be independent of the rest of the world, for we might enclose the State with a high wall and get along just as well, since we produce within our borders everything that we need. This boast was based on the fact that North Carolina puts something in every column of the blanks sent out by the Agricultural Department at Washington, that she produces a little of everything; but the inference drawn from this fact is far from being true. Not a single county in the State produces food-stuff sufficient to sustain its population. As our towns and cities have grown, the relative food production has diminished, and in most of our counties this diminution in the amount of food produced has been not only relative but absolute.

For the last score of years the population of our towns and villages has increased as families have gone from the farms to the factories, often to live off the labor of the children, or from the rural districts to the city in order to give the children better schooling. The increase of our population from outside sources, too, has helped to swell the urban population. But farm lands are not increasing, the acres planted with food stuffs have steadily diminished in number, and under our old system of cultivation there has been a steady diminution in the value of the returns per acre. Even

Orange County, which may be reckoned a rural district, does not begin to make food enough to maintain its inhabitants through the year, and the inhabitants of our adjoining county of Durham would starve in less than a fortnight if they had to depend on the food product of the county for support. When some of us in this hall came to college the village of Durham could claim no other distinction than that of being the railway station from which students drove to Chapel Hill. Today it is a city of more than 20,000 inhabitants, drawing its population from all parts of the world, and dependent upon distant fields for its support. And not one of our large cities, Wilmington, Charlotte, Asheville, Greensboro, or Raleigh, could depend on its own county, or even upon the surplus of a score of adjoining counties, for its food.

Notwithstanding the several years of unprecedented crops that we have had, amounting almost to seven years of plenty, we are practically face to face with a famine. The wheat lands of our own Northwest have been practically exhausted of their lime, as an acre of wheat will use up ten pounds of lime in coming to maturity; and this loss, added to the damage done the soil by the poisons excreted by the roots of the wheat, has caused our farmers of the great plains to seek new fields in the Canadian West. Already the natural pasturage of our semi-arid regions has been practically exhausted, and neither cattle-raising nor sheep-raising is profitable, where within two decades vast fortunes have been made in these industries. Those of you who paid your month's butcher's bills on the first of May were doubtless led by their unusual size to investigate causes, and learned that for the first time in the history of the Chicago and Kansas City packing houses they have not been able to fill their cold storage. The demand of the country for fresh meat has consumed the entire output of these houses during their busy season. And this state of things has come about after three years of abundant crops, during which time the packing

houses have paid their own prices for meat. Now let a drought come and there is absolutely no escape from a meat famine.

But what are we going to do about it? What is the solution of the problem? We are all familiar with the fact that in our older States of the South the annual product per acre has greatly decreased, owing to the rapid loss of soil fertility, and that even our moderate production is maintained only at increased cost; and also, that the comparatively new States like Texas, as well, show a rapid deterioration of land and loss of fertility. And it may be pointed out that our farmer is of all men most miserable; neglected and looked down upon; slave to the credit system; servant where he should be master; poor and becoming poorer; the prey of sharpers; the disconsolate follower of a calling which he has inherited with his deteriorating acres, clinging to the past, knowing no higher law than chance, planting, rearing, and gathering his crop under the leadership of luck, each succeeding year seeing his granary heaped fuller of disappointments, leaving him poor in purse and lean in hope. None of us can deny that this is a true picture of the average farmer of our State as we have known him from our youth up. The politician who has flattered him biennially that his calling, seen in its true perspective, is outranked by no other in power, scope, or service to mankind, has gone his way and made laws directly opposed to all the farmer's interests.

Still, what are we going to do about it? How are we to escape famine if our present source of supply should be exhausted? What is the solution of the problem? Increase the output from the soil that we have by the application of science—"that sensible science of our day which has for its ultimate aim not merely discovery but application; which is not so delighted by the formulating of a new law as it is overjoyed at the lifting of a burden;" science, in which laboratory investigation goes hand in hand with field experimentation, the science of our present time, which is applied

common sense, combining laboratory practice with business-like methods. Such science our United States Department of Agriculture is engaged in and encouraging; so also the various State agricultural experiment stations and most of the agricultural colleges, corn breeders' associations, truck growers' associations, sugar producers, tobacco growers, private investigators like Luther Burbank, all laboring to lift the burden from the agriculturist, and make him indeed what the politician has been flattering him that he is. Greater progress has been made in all departments of life dependent upon the soil in the last score of years than in the previous two score centuries.

The most important of all this service of science to the farmer bas been the study of the soil, the fundamental factor in all the varied lines of life that branch out from agriculture. How to save it, how to nourish it, how to restore it to life when dead, what it is composed of, how it is formed, how to interpret it so that any man may understand it—these have been, and still are among the great problems before us. Their solution is being worked out and already that work has revolutionized agriculture within our own State and is slowly changing conditions for the better in the entire South.

Tobacco is grown in eastern North Carolina today because a soil investigator found out that the marls just beneath the soil there contained in available form the lime that the tobacco plants require for their growth, and of course all the other essential minerals are there. Hitherto tobaccos had been grown on limestone soils, or on soils derived from igneous and metamorphic rocks rich in lime-soda feldspars.

In a similar manner it was discovered that the sands of the sand-hills regions of the Carolinas contain both lime and potash in available form, whereas similar sandy soils of Western Europe are practically devoid of these necessary plant foods, but this soil is particularly adapted to the growth of the vine, and in consequence an important grape industry has grown up in our sand-hills district.

Similarly it was found out that certain incoherent white quartz sand in Florida was valuable pine-apple soil, notwithstanding it was over 99.5 pure quartz, because it possessed certain properties that the bacteriologist discovered.

Investigation showed that the soil of the Connecticut Valley, which produced only low grade tobaccos, sneered at as Connecticut cabbage leaf, was essentially the same as that which produced the Sumatra tobacco. But it was necessary to change the climatic conditions, and this was done by the use of cheese-cloth, increasing the humidity and raising the mean temperature ten degrees Fahr. Somewhat similar experiments have been tried in Darlington District, South Carolina, the result, so far as the production of Sumatra wrappers was concerned, being entirely satisfactory. And such investigations and experiments have been carried on all the way from Connecticut to Alabama and Texas with the result of greatly improving the product and greatly increasing the output, producing in the Southern States the cigar tobaccos of all lands.

This matter of the investigation of soils is by no means new, though its methods and their application to agriculture are matters of little more than a decade. Such investigations were begun by Liebig at Giessen more than half a century ago. He and his assistants made countless analyses of the ashes of plants. These showed the presence of different minerals in every species, that each species requires from the ground the same class of salts, and hence that it must sooner or later exhaust the supply of these salts in a given plot, and render it unfit for the growth of the species in question unless fresh supplies are provided.

"Liebig attempted to give the necessary supplies in the form of 'Mineral Manure', and soon set to work to study practically the effect of mineral manures on a large scale. In the year 1845, previous experiments in a garden having proved unsatisfactory, he purchased from the town of Giessen about ten acres of barren land—a sand pit, as he says, which

surpassed all the land in the neighborhood in its barrenness for ordinary cultivated crops; in the year this land hardly grew so much fodder as would have sufficed for a single sheep. It consisted partly of sand, partly of coarse quartz and pebbles, with strata of sand and some loam.

"Some of the soil was first tested by sowing it with seeds in pots after enrichment with some single mineral manure, with the result that not one of the plants got beyond flowering; this showed that the soil was bad enough for his purpose of testing the value of minerals as manure.

"A number of mineral manures were then prepared for him according to prescriptions based on his analyses, and these were spread over the land; next he sowed on different subdivisions of it wheat, rye, barley, clover, potatoes, turnips, maize. In some cases he added sawdust to the manure, and in one case he used stable manure; otherwise no ammoniacal manure and no mineral matter was employed, except that to one plot he applied some forest soil and to another a mixture of forest soil and mineral manure. Even in the first year he had a harvest; the best results were given by those plots in which mineral manures were mixed with forest soil or stable manure. This, as he says, enabled him to correct his earlier ideas of the functions of humus, which by its decay renders an extra supply of carbonic acid gas to the plants that is especially valuable at the early stages. Gradually, without any other supply of manure except mineral manure, the land so improved in productiveness that in the fourth year his crops excited the wonder of all who had known the original state of it.

"In 1849 this little farm was purchased by his gardener, who was then able to farm it with profit, raising some cattle on it yearly and getting such satisfactory crops of corn that in 1853 a neighboring farmer wrote: 'With us the wheat crops are very poor, but on the height (Liebig's plot) they have harvested three fuder of rye twelve simmer, while I from three fuder of the best rye, have only got five simmer.

If you were to see it, you would be astonished; it is truly wonderful.' "

From his experiments with this land Liebig was led to form the opinion that it was possible, by giving the soil proper physical quality and composition, to bring about a state of things in which sufficient ammonia to maintain its fertility can be collecteed or condensed from the air. He recognized not only that certain elements were necessary in a fertile soil, but more—and what certain soil chemists have been slow to recognize—that these elements must occur in certain combinations as minerals to be available as plant-food. He found, too, that certain earths and other substances might be added to soils, which would withdraw to some extent soluble salts from their solutions, removing from the soil substances injurious to plant life. Liebig was greatly interested in the experiments made in England by Sir Thomas Way on the absorptive power of soils, and was the first to recognize the true value of these experiments to agriculture.

Thus it was that a chemist sixty years ago recognized that the study of soils was as much the province of the geologist, the mineralogist, and the physicist, as of the chemist; and the work with which he is credited in Denmark shows that he also regarded it as within the province of the botanist. So greatly did he value the structural features and mineral composition of a soil as indicators of its fertility, that he said: "In matters of this kind the farmer must pursue his own course.....he must not put the least faith in the assertion of any foolish chemist who wants to prove to him analytically that his field contains an inexhaustible store of this or that nutritive substance."

In other words, Liebig saw that it is not so much the chemical elements in a soil as their mineral combination which determines their available plant food, and the geologists have found that very different rocks may be made from the same molten magma under different conditions of cooling. And it was Liebig who pointed out to the farmers that they

might change the fertility of their soil by changing its texture. In examining into the improved conditions of agriculture in the dune districts of the Jutland Peninsula a number of years ago, I found that the farmers of that country attributed their prosperity wholly to the suggestions made to their fathers and grandfathers by Liebig who went to Denmark to study moving sands; but I have not been able to find that he ever published anything on the subject.

But the dream of Liebig is being realized, and the study of soils is enlisting the closest attention of the chemist, the geologist, the mineralogist, the bacteriologist, the botanist,—a relatively small but powerful coterie of men who are the investigators and interpreters of modern agriculture. The chemist has found the essential plant foods, the geologist has noted the natural distribution of vegetation with relation to rocks both as to composition and structure, the mineralogist and geologist have studied the rock-making minerals in relation to their available plant-foods, the bacteriologist has shown us that certain living organisms in the soil are of enormous importance to every man who raises food for man and beast, the botanist has busied himself with breeding certain plants adapted to certain soils. "Knowledge is now no more a fountain sealed." The farmer of to-day may, nay he must, come up to his calling "as fully equipped for service as the lawyer, the editor, the doctor, the captain of industry; for the curious fact has developed that the calling in which the unlettered and untrained man was once supposed to have as good a chance as the educated one, is now the calling in which wide and varied knowledge is almost as imperative as in almost any other known among men."

Of the more than seventy elements that make up the crust of the earth only about a dozen are essential to successful agriculture and practically all soils contain these in one form or another. Only four of the twelve—nitrogen, phosphorus, potassium, and calcium—are liable to be lacking in

any given soil. But when any one of these four is wanting dire results follow.

The results that may be obtained, even where all these elements are present in proper proportion, depend upon the size of the soil particles, upon the number of grains of soil in the little measure of a gram; for the freedom with which the film of soil moisture moves over the soil grains determines the amount of plant food taken out of the soil. If the farmer is a raiser of truck for the early market, the soil for his lettuce, peas, beans, onions and radishes must be of a certain well-defined structure—it must have at least one billion, nine hundred and fifty millions of particles in a gram, in less than a thimbleful of earth. If he is going in for ordinary summer and autumn vegetables, corn and cabbage and potatoes, then there must be at least two billion additional particles in each gram of soil. If he is a wheat planter he must be sure that there are not less than ten billion, two hundred millions of particles in his little thimbleful of soil; while for wheat and grass land combined the soil must be in finer particles still.

While it has been known for at least two centuries that bacteria exist in the soil, it is only recently that they have been studied with any degree of satisfaction. They exist everywhere in earth and air and sea. They were believed at one time to have animal life, but they are now almost universally accepted as low forms of vegetable life. Over a thousand different kinds are now known, and the list is being steadily added to as knowledge of them increases. They increase by dividing themselves in two, and this they do at a marvelous rate of progression. One of them, according to a bacteriologist who has studied it closely, would, if left to itself, produce seventeen million descendants in twenty-four hours. Another scientist calculates that another particularly rapid multiplier could produce, if it had penty of food, four thousand seven hundred and seventy-two billion progeny in a single day. They differ from plants which we see growing

about us in that they have no chlorophyl—the material which gives the green color to the plants.

In a Kansas soil it was found that there were as many as one billion, six hundred and eighteen million, six hundred and eighty-one thousand, eight hundred and ten bacteria in a single gram or small thimbleful from a field under examination, while another field nearby had only a few over a million. As air is necessary for their existence, they rapidly decline in numbers as you go down in the soil to a point where none is ever found.

Many different families of these bacteria live in the earth, making their homes in the soil. They help to decompose it, thus transforming it into food. They draw vast stores of food supplies from the air. At every point they act as agents in advancing the interest of man.

Four-fifths of the air we breathe is one of the most valuable plant foods, nitrogen. Some of this nitrogen is available in one form and some in another, but it must all be put into such form that it may pass into the system of the plant and be utilized in the building up of stalk and leaf and ripened seed.

In portions of North Carolina I have seen a field worn out by injudicious cropping, the plants struggling to grow in a depleted soil into what would be at best but a lean and starved maturity. In an immediatly adjoining field, with a soil of precisely the same character, with no advantage in point of moisture, heat, or sunshine, with precisely the same kind of seed planted as in the first case, were tall, strong, and thrifty plants, neighbors to the thin, yellow, beggarly ones of the first field.

The only difference between the two was that when the seed were planted there was sprinkled in the rows of one field some plain simple dirt brought from another State, and the field that had this dirt sprinkled in its rows was the field with the strong and vigorous plants. What wrought the wonderful change was a colony of nitrifying bacteria, living,

moving things, that helped the crops to get their nitrogen from the atmosphere. Long ago it was discovered that certain plants, as the beans, clovers, peas, vetch, alfalfa, and the like, form upon their roots little bunches of tubercules, as they are called. When science sought out the meaning of these tubercules, why they formed on these particular plants, what purpose they served, it was seen that they were not abnormal, but necessary, and that plants that had them were more thrifty than those that had them not. It was discovered that their task was to take nitrogen from the air and transform it into nitrogen suitable to be taken up by the plant.

Having learned, then, the soil conditions necessary for plant growth, the next thing is to apply them.

Residual soils, those found upon the rocks from which they are derived, have certain definite characters determined by the characters of the rocks beneath, and they are not apt to deteriorate, since their source of food-supply is immediately at hand, unless the fine particles are carried away by erosion faster than the rock beneath can rot into soil. Transported soils, on the other hand, are very readily exhausted, since they are far removed from the parent rock, and they need to have their supply of plant-food constantly replenished by the use of fertilizers. One way of keeping up the fertility of the soil is by rotation of crops requiring different plant-foods.

The best way to farm is to plant in each field the crop to which the soil of that field is by nature best adapted.

But we often desire, or actually need, crops to which the soil of a given district is ill-adapted. Since we cannot change the soil materially, the difficulty is met by breeding plants to suit the soil, and what has been accomplished in this direction is little short of miraculous.

The wasting of soils where serials are grown, and the gradual reduction, year by year, in the yield of these crops, has led more than one thoughtful student of human condi-

tions to predict a time, and that not very far distant, when there will not be bread enough to go around.

While enough has been done in the restoration of worn out soils to show that the time is farther away than was at first feared, much more has been done in the breeding of new varieties of wheat and corn to take the place of the old and unsatisfactory ones. New wheats have been created not only showing larger yields and as great nutrition in experimental plots, but in the thousand-acre farm of the advanced American Agriculturist as well. More than this, wheats have been bred to fit a climate, redeeming vast areas of abandoned land supposed to be wholly unfit for wheat production.

New corns have been created, far richer in food values, far larger in yield, than the best known types of the past. More than this, corns have been created at the command of man for any one of a series of specific purposes—to be rich in one element and lean in another, to be food for man or food for beast. They are, in a word, as much the creation of man as the beautiful vase in the hands of the potter.

The experiment station of the University of Tennessee determined to breed a wheat that should fit the soil and climate of that State, where no wheat would grow and produce good results. When the experiments were begun, eight bushels to the acre was a fair average yield. After several years of testing, breeding, and selection, they have produced a wheat that has produced as high as forty-eight and one-half bushels per acre on the same land, while maintaining an average of over thirty-seven bushels for a period of four or five years. And we in North Carolina have reaped the benefits of this and similar experiments elsewhere in the extension of wheat producing area to the poorer lands of the eastern part of the State.

When we consider corn, the greatest cereal in point of value of annual production in the United States, the results achieved are even more satisfactory. The object sought in breeding new corns was not only to produce corn with a heavier yield,

but to change the character of the corn itself. Corn for human food should be rich in one element. Corn for manufacturing into any of the various products which are now made from it should be rich in certain other elements.

So the corn kernel was studied in order to find out precisely what it was made of, that by selective breeding this might be changed. By taking kernels from a series of ears known to be rich in one particular element, and breeding from these ears year in and year out, carefully selecting for future seed only the richest and best kernels and only those approaching the ideal established, little by little, with infinite pains and patience, new corns have been built up having the desired character and composition.

A manufacturer desires corn for the production of oil, now one of the most valuable products of the corn plant. It is in large demand among the olive-oil manufacturers of Europe. The oil comes from the fat in the tiny germ of the corn, and the larger the germ the greater the supply of oil. Corn-oil is in demand for many other purposes, and it appears to be but at the beginning of its commercial life. Hopkins in Illinois has succeeded in producing a corn relatively much richer in oil than any that has preceded it, one having 6.96 per cent. oil while the corn with which he started only six years before contained only 4.7 per cent. of oil. To some manufacturers the fat of the germ is not essential, so, to accommodate these, he reversed the process and bred a corn low in fat or oil, reaching 2.99 per cent.

The element of the corn which is most valuable for strengthening food, which is the muscle-building material of all food, has also been increased at will, and where it could make way for some other element suitable for some other purpose, it has been decreased. All this has been accomplished by selective breeding. Corn has been produced having 16.11 protein, a remarkably large amount, while the protein has been reduced to 6.66 per cent., a difference in protein of nearly ten

per cent. Corn is also bred for a large amount of starch, and similarly useful results follow.

The breeding of corn has gone to yet another extreme, the breeder having succeeded in doing away almost entirely with the grain and producing a large, firm cob. These cobs, that are produced on some of the poorest land in Missouri, are used for making the corn-cob pipe, and the introduction of the Collier corn into that district has been a Godsend to the poorest farmers with the poorest lands in the State. A very similar result has recently been obtained in Illinois, where a large firm cob with an insignificant grain has been produced on a soil of nearly pure siliceous sand. It has been found that the pith of the corn cob is a most valuable substance for calking ships and stopping leaks, the pith absorbing water and swelling to fill the crevice, and corns have been produced with a maximum of pith in the cob.

The corn of our mountain districts is rich in fat, and there too is the only portion of the South where we may raise sugar corn with success. The longer season in the lowlands admits of the elaboration of the fats into proteids. It is interesting to note in this connection that the corn of our mountains and the corn of the north are rich in heat producing elements, while these are almost entirely wanting in Southern varieties of corn, the long growing season admitting of the change of the sugars and fats into proteids. We cannot even raise sugar corn in our coastal plain from the seed of sugar corn grown there, but must get our seed each season from a colder region. The same is true with regard to the seeds of cabbage grown in the South except in the mountain region.

The changes in the character of corn are in no small measure the work of members of the corn-breeders' association, and show what may be accomplished through co-operation among farmers. This association has been working to make corn a complete ration. Here in the South, Williamson has greatly improved corn both as to quality and yield per acre, by a method peculiarly his own. The seed has been planted

and allowed to grow with grass and weeds until the plant has reached a weak maturity and is just ready to bear grain. Then the grass is cleared out, the corn well worked and heavily fertilized, when its stimulated growing energy goes all to fruiting. It has its parallel in the intellectual activity of the boy who comes from the back districts where he had no advantages of an intellectual sort, but his energies being aroused at the right moment, often surpasses his more fortunate associates in his college course and in the race of life.

Some of the most interesting experiments in plant-breeding have resulted in the production of food stuffs adapted to semi-arid regions, and these are of especial interest to us for the reason that we have a long strip of semi-arid land in the South, lying mainly in the sand-hills region and immediately bordering that region on the northwest, little more than a barren sand-waste until the introduction of new methods and new plants suited to its conditions.

Alfalfa has been bred to resist both drought and alkali, and it has also been found in nature. Agents of our Agricultural Department searched the earth for what was needed, and found just the thing desired growing in an oasis of the Algerian Sahara. Luther Burbank has bred a spineless and edible cactus admirably adapted by nature to such regions, and this may yet become an important food plant in certain portions of the South.

Rice forms the principal food of one-half the population of the earth. It is more widely used as a food stuff than any other cereal. Where dense populations are dependent for food upon an annual crop, and the climate admits of its cultivation, rice has become the staple food. The luxuriant growth of leguminous plants (peas, beans, etc.) in warm climates provides the nitrogenous elements necessary to supplement rice. A combination of rice with legumes is a much cheaper complete food than wheat and meat, and can be produced on a much smaller area.

The Carolinas in the decade ending 1860 produced approxi-

mately eighty-five million pounds of clean rice. Now the total product for a like period is only about thirty-five million pounds, of which North Carolina only produced about seven million. But the total rice product of the entire South has advanced from 103 millions to 143 millions in the same time, thanks to the valuable investigations of and improved methods introduced by Dr. S. A. Knapp, of the United States Department of Agriculture.

Horticulture is coming to be a most important branch of agriculture, and its surprising progress has already been so fully discussed in our newspapers and periodical literature that I need do little more than advert to it here. Suffice it to say that in 1870 the export of fruits preserved in cans or otherwise from the United States to foreign countries amounted in value to $81,735.00. Ten years later the value of the canned fruits exported had advanced to $371,118.50. In 1890 it was over $600,000.00, and in 1900 had passed two millions. This does not give us any indication of the enormously increasing domestic consumption of fruits.

It is an interesting fact that the traveler of to-day does not find his way across the desert by the bones of men and beasts that have started on the perilous journey before him, but by the shining tin cans left by those who have made the journey in safety.

This progress in fruit growing has been made possible by the breeding of fruits to suit different climates, and by the importation of insects to prey upon the insect enemies of fruit trees.

Already our trucking interests have made the South the garden of the nation, for we have here the broad coastal plain soils that yield readily to cultivation; but business methods have gone hand in hand with the application of scientific methods and are always equally important to the agriculturist. The managers of the truck-growers' association see to it that the crops come on in regular rotation from Florida, Georgia, the Carolinas, Virginia, and Delaware.

The Strawberry Trust at Selma, a North Carolina organization, has an agent who gets each night reports from all the strawberry eating cities as to the number of crates of berries on hand, and he then learns from the fields how many they can supply, and an effort is made to keep the shipments just a little short of the demand. Then by uniting their shipments and sending them forward in carload lots, the shippers get a better rate and quicker transportation.

Notwithstanding the South produces so much rice, and the entire product of the country, still we produce only half of what is consumed in the United States; but with the improved methods of cultivation, it will be but a short time before we produce enough for the entire nation.

Of corn we can produce every variety from our coastal plain to our mountains, and corn culture is extending about as rapidly as the culture of rice. The culture of wheat is extending as new varieties are being bred for our lands, and wheat culture is extending into regions where wheat has never before been raised. New varieties of potatoes have been produced in our potash soils, and already the best of these are grown in the South, and the rapid extension of their culture will soon make us the most important potato producers in the country.

Of cotton, we have not simply the monopoly of this country, but practically the world's monopoly as well. Experiments carried on at Darlington, S. C., have resulted in the production of a long-stapled cotton that will grow far from the sea islands. And the new methods of tobacco culture are showing us that we can produce all the grades of tobacco, and these in any quantity.

Thus we already have the garden of the nation; we may become, nay, are rapidly becoming the nation's field for the production of food stuffs; and whether we will or no, we will soon be the only forest that the nation has left, except in the national forests scattered over our broad domain.

Forest trees depend more directly upon rock composition

and geological structure than any other products of the soil. This is beautifully illustrated in our State where conifers predominate over the coastal plain and sand hills region, and the broad-leaved deciduous trees over the granitic and schistose rocks farther west. Within these areas species and varieties vary with the changes in character of the rock and the change of its dip helping or hindering drainage. This is beautifully illustrated in the neighborhood of Chapel Hill, where our Triassic sandstones bear the loblolly pines, except where the rocks are cut by dikes, and then you may trace the dike by the broad-leaved trees that grow upon it. The crystallines of the Chapel Hill mass have their characteristic diciduous species, and these again vary as the rock structure changes.

We have in the Appalachians practically the only hard wood forests on the continent, and many of the most valuable species are confined to the Southern Appalachian mountains. In the north these forests have been ruined by the destructive work of the lumberman, before the introduction of the methods of modern scientific forestry; but here we already have the forest of the nation if we will but preserve it, and upon its preservation depend the field and the garden.

Our fathers had a true instinct when they pictured a great civilization in the South based upon the soil. Their vision is to be more than fulfilled when Southern agriculture can bring to its aid science, that sensible science of our day, which has for its ultimate end not merely discovery, but application; which is not so delighted with the formulating of a new law as it is overjoyed at the lifting of a burden. "Then the tiller of the soil will come up to his calling as fully equipped for service as the lawyer, the doctor, the captain of industry; for it has come to pass that the calling in which the unlettered and untrained man was once supposed to have as good a chance as the educated one, is now the calling in which wide and varied knowledge is as imperative as in almost any other known among men."

Men have also come to the same views as those expressed by the King of Brobdingnag, who "gave it as his opinion, that whoever could make two ears of corn, or two blades of grass to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."

And better still: While the politician of the not very remote past flattered the farmer and yet made laws directly opposed to all his interests, the new politician in the South shows constructive statesmanship by helping him to take advantage of the opportunities around him, helps him with his inland waterways, helps him to preserve his forests.

SOME INTERESTING GRASSHOPPERS (AND RELATIVES) OF NORTH CAROLINA.

BY FRANKLIN SHERMAN, JR.

The grasshoppers and their relatives comprise the order of insects known as the Orthoptera. The entire order contains probably about 150 species native to North Carolina, of which about 130 have now been collected, identified, and recorded.

There are not many students of Orthoptera in this country and what few entomologists there are in the Southern States have neglected the group entirely, hence practically nothing was known of the actual distribution of our species until 1903, when Prof. A. P. Morse, of Wellesley College, made a special tour through the Southern States to study this subject, and, partially through the entreaties of Mr. C. S. Brimley and the author, he devoted more time to North Carolina than to any other State,—traversing it from east to west and then again visiting the high ranges in the western section. During his tour, Prof. Morse spent two days at Raleigh, at which time Mr. Brimley and the author accompanied him in collecting jaunts with the result that our latent interest in this neglected order was considerably aroused. The facts set forth in this paper have, therefore, for the most part, been collected in the last three or four years, by C. S. Brimley, G. M. Bentley, and the writer.

While no one can seriously study this order of insects without becoming interested in the special structures and their use in classification, as well as in the habits of the living insects,—yet there are about a dozen species which would more particularly arouse the interest or curiosity of the ordin-

ary observer, and to mention these is the special object of this paper.

Labidura riparia. This insect belongs to the family of insects known as the "Ear-wigs". The group is abundantly represented in Europe, but only sparsely in America, the few American representatives, however, being more especially distributed in the Southern States. Most of our ear-wigs are of small size, ranging from one-half to three-fourths of an inch in total length. In mid-April of the present year a janitor brought to the office a living specimen of this species, a fine large male, the first to be taken in the State.

Cryptocercus punctulatus. This insect belongs to the family of roaches, a few species of which infest houses, though more are found in the forest. The present species has been taken in four localities in this State, three of which are in the mountains, the exceptional locality being Newton. It is rather a large species, is entirely wingless, and is rather slow and stiff-bodied in movement, in which respect it differs from most other roaches. Our specimens have all been found under logs, in the months of July, August, and September.

Stagomantis carolina. This creature is most commonly known by the names of "Rear-horse", "Devil's Riding-horse", "Praying Mantis", and other expressive common names. It often arouses curiosity by its peculiar appearance and demeanor. It probably occurs throughout the State, at least east of the mountains, though we have had specimens from only a few localities. It is the only member of the Orthoptera in the State which is known to be predaceous in habit.

Diapheromera femorata. This insect is also known by the name of "Walking-stick", so called because its very slender body gives it a resemblance to small twigs, and because the insect always deliverately *walks*, and never runs or jumps. All through the summer the young insects are greenish in color, corresponding to the color of young twigs and the petioles of

leaves among which they live, but in the autumn when the leaves fall and the twigs become gray or brown, these insects, being then near maturity, turn gray in color. These remarkable resemblances, combined with their deliberate movements, render them quite difficult to detect, unless they force themselves accidentally upon one's notice.

Eritettix navicula. This is one of the true grasshoppers, which so far as has been observed inhabits rather low, grassy grounds. It is an exception in that it is the only species which has the antennael enlarged into a knob or club, at the tip.

Trimerotropis saxitalis. This very remarkable grasshopper is an inhabitant of the exposed, lichen-covered surface of the rocks on some of our mountains. In his trip through the Southeastern States Prof. Morse failed to take it in this State, but recorded its presence on the summit of Stone Mountain, in Northern Georgia. In September last (1906) Mr. Woglum and myself took it quite commonly in favorable spots on the summits of Satula and Whiteside Mountains, near Highlands, Macon County. The species bears a remarkable resemblance to the lichen-covered rocks on which it is found, and when flushed will invariably settle again on the rock, it being only in most exceptional cases that they could be persuaded or forced to alight in grass or herbage. When cornered they would quickly fly back within a foot or two of the collector to again reach the rock, although the species is quite shy when once disturbed.

Leptysma marginicollis. This species is found in grassy places where it clings to the upright stalks or blades, so closely applying its body to the grass as to render detection difficult, both the shape and color of the insect being protective. One remarkable feature of this insect is the fact that the front of the head (or face) slopes away under the body in such degree that the mouth is situated almost between the front legs.

Melanoplus punctulatus. The genus Melanopsus contains many species, the majority of which are not especially striking in appearance or habits, but this species is an exception in that, while all the other species habitually live on the ground or on low-growing grass or herbage, this one is considered to be strictly arboreal, occurring on trees, stumps, shrubbery, etc. Our one specimen of this species was taken in Transylvania County by Mr. Woglum, and is mottled in appearance, which renders its color protective when on lichen-covered bark. It is likely that the species does not occur east of the mountains in this State.

Dissoteiria carolina. This is one of our most common grasshoppers, and in nature (if not in the cabinet) is surely familiar to most observant country people in this State. Among those who have any common name for it, it is known as the Carolina Locust. It occurs throughout the State along roadsides and in cultivated fields. The remarkable thing about this species is the variability of its protective colors. In sections where the soil is grayish in color there the insect is grayish, while only a mile away may be found red clay soil and grasshoppers of a decidedly reddish tinge. Not that the resemblance is perfect, but the difference in color of specimens taken on differently colored soils is quite noticeable. On one occasion in Raleigh I took a specimen on a railway embankment and the greater portion of the body was blackish to correspond to the soot and cinders among which it was found, No similarly colored specimen has since been taken anywhere, and others were not seen at that time.

Gryllotalpa borealis. This is commonly known as the "Mole-cricket", so called from its habit of burrowing in the ground like a mole, and from the further fact that it has developed along very similar lines, the front limbs being much enlarged like the front paws of the mole, and like them are used for digging.

Myrmecophila pergandei. This small and wingless cricket

is found beneath stones in company with ants, whose nests they inhabit, and in consequence of the darkness prevailing in its usual haunts, is white in color. Thus far it has been taken only at Raleigh, though doubtless it occurs in other localities.

Tridactylus sp. This is a small, blackish species taken at Raleigh early this month for the first time. It was found in low, sandy ground in which it frequently disappeared down very minute burrows. When disturbed or alarmed they jump with marvelous agility, their small size causing them to instantly disappear from view when they once leap away. After capturing several specimens by laboriously approaching them with the killing bottle, we finally began to walk rapidly over the ground and sweep the collecting net back and forth at random, and by this means secured them in considerable numbers.

NOTES ON SOME TURTLES OF THE GENUS PSEUDEMYS.

BY C. S. BRIMLEY.

The genus Pseudemys comprises a number of large fresh water turtles found in the streams and ponds of North America. These have the carapace marked with a more or less variegated pattern of light and dark colors, and are distinguished from allied genera by the broad masticating surfaces of the jaws, which are in the upper jaw divided by a longitudinal ridge parallel to the margin.

The species dealt with in this paper fall more or less naturally into three groups, which are characterized as follows:

GROUP I. Upper jaw with a notch at the symphisis and a cusp or tooth on each side of the notch. Lower jaw, at least, strongly serrated. Ridges in masticating surfaces of jaw tuberculate.

GROUP II. Upper jaw without either notch of cusps, otherwise as under Group I. Plastron always yellow, unblotched.

GROUP III. Upper jaw notched at symphisis, but without cusps. Edges of jaws not serrated. Ridge in masticating surface of jaws not tuberculate.

Group I comprises three nominal species, *P. rubiventris* LeConte, *P. alabamensis* Baur, and *P. texana* Baur. Of these the first and last are certainly distinct species, but the second, of which I have seen no specimens, may be the same as the first.

Of *P. rubiventris* I have seen only one specimen, this be-

ing a live individual from Orlando, Florida, which measured 267 mm. over curve of shell, 245 in straight line, 167 in greatest breadth, 110 in greatest height. Shell strongly arched. Carapace black with red markings, marginal plates with much red below, plastron yellowish brown, but reddish in front and behind, legs with red stripes. The head markings I couldn't see, as he would not put his head out. Lower jaw very strongly serrated, with a serrated cusp at tip; upper jaw slightly serrated, with a median notch and a strong cusp on each side of it. Date, March 16, 1902.

Alabamensis, according to Baur,* has the shell more arched than in *rubiventris*, and the plastron is yellow with brown markings, instead of red as in *rubiventris*.

Of the third species of Group I, *P. texana*, I have seen only two undoubted specimens, one a living specimen from Colmesneil, Texas, measuring 284 over curve of shell, and 265 in straight line; greatest width 215. Shell smooth, not wrinkled, and without traces of a keel. Color slaty brown with yellowish markings, the markings on the costal plates transverse to the longitudinal axis of the shell. Marginals each with a vertical yellow bar down the center. Plastron yellow without markings. Both jaws serrated, the lower much the most so; upper jaw notched in front but without cusps. Date, July 7, 1902.

The second specimen, which was from Shell Bank, La., was much the same color, and had the upper jaw notched in front, with a slight cusp on each side of the notch. Other characters, as in the first specimen. Length in straight line 225, width 150. Date, July 27, 1903.

Group II includes five nominal species, *P. concinna* LeConte, *P. mobiliensis* Holbr,† *P. floridana* LeConte, *P. hieroglyphica*,

* "Notes on the classification and taxonomy of the Testudinata, part IV, The species of the genus Pseudemys" by G. Baur. (Proc. American Philos., Soc. XXXI, May 5, 1893).

† According to Dr. Baur (*loco cito*), *P. mobiliensis* Agassiz is not the same as *P. mobiliensis* Holbr., the former being a composite species equaling *P. alabamensis* Baur plus *P. texana* Baur.

Holbr, and *P. labyrinthica* C. Dumeril, but how many species it really contains I don't know, as individual variation in at least one species seems quite wide and obliterates the distinctive features ascribed to most of the others.

According to Dr. Baur (*loco cito*) these species are characterized as follows:

Concinna by its broad and low shell and its small head.

Hieroglyphica by its elongated, narrow shell and its head, which is still smaller; the yellow stripes and dots on the head are also very much more expressed than in *concinna.*

Labyrinthica shows the coloration of head and neck of *hieroglyphica*, but the head is larger and the shell more as in *mobiliensis*, but by far not so large.

Mobiliensis has the head like *concinna*, but larger, the shell very much more arched especially in front, the animal much larger than in *concinna*, the upper shell reaching a length of 385 over the curve.

Floridanus is at once distinguished by its oval form and the great elevation of the carapace and its color. The carapace has a very dark brown color with numerous irregular lines of yellow. The marginals are dark brown and have only one vertical, median yellow line, and are without the yellow concentric lines so characteristic of *concinna* and *mobiliensis.* The carapace is much more arched than in *mobiliensis* and nearly forms a half circle. The skull is also larger than in this species and the jaws are not serrated (*sic*).

The characters quoted above, except those for *floridanus*, all fall within the range of individual variation of Raleigh specimens of *concinna*, and hence until I am able to examine specimens of the others, I cannot help feeling doubtful of their validity.

Raleigh specimens of *concinna* present the following characteristics: The carapace is marked with a variegated pattern

of brown and yellow lines, these forming more or less distinct concentric figures, parts of three of which usually enter each costal plate. Markings of the carapace usually not definitely transverse to the axis of the body, on the costals. Marginal plates marked above with a median, vertical, yellow bar, and yellow concentric figures between the yellow bars of adjoining plates; quite frequently, however, the vertical bars are absent on some of the plates and the concentric figures replaced by longitudinal yellow lines, continuous on adjoining plates, this occurring on the middle and posterior marginals, but not usually on the anterior ones. In seven adults this feature is present or absent as follows: In one the longitudinal lines replace the vertical bars and concentric lines on all the marginals; in two others they do not occur at all; in a fourth they occur only on marginals 4, 5, 6, right, and 11, 12, left; a fifth has them on the four middle marginals on each side; a sixth on numbers 5, 9, 7, right, and 6, 7, left; a seventh, on numbers 4, 7, 8, 9, 11, on both sides, and on No. 12, right also. The presence of a vertical yellow bar across the center of each marginal is so constant in all specimens of *Pseudemys* that I have seen, except those from Raleigh, that the variation seems worth noting. Head and legs with yellow stripes. Plastron yellow, unblotched.

In the shape of the shell there is also a good deal of variation, some specimens being broad and flat with a median, dorsal depression; others are broad and flat but lack the dorsal furrow, while others again have comparatively high and arched shells, and in any case the dorsal depression is only present in full grown specimens, not in young nor in half grown ones. The flat shelled specimens seem to be mainly males, and the more arched ones females, but I have not examined enough specimens to be sure that the variation is wholly sexual and not individual.

The size of the head also varies, being large in some specimens and small in others, the difference being apparently

sexual, the small headed ones being males,* the large headed ones females. Young specimens are nearly circular with a distinct dorsal keel, as in all young *Pseudemys*, but a specimen 130 mm. long has substantially the form of the adult.

Some measurements of specimens from Neuse River near Raleigh are as follows:

	Taken.	Greatest Length.	Width.	Height.
1.	Feb. 26, 1902, sex?	131	107	55
2.	April 23, 1906, male	150	114	54
3.	March 29, 1904, female	161	—	—
4.	July 27, 1903, sex?	202	139	—
5.	March 24, 1903, male	211	150	82
6.	March 29, 1904, female	240	158	—
7.	June 2, 1905, sex?	240	172	80
8.	March 24, 1903, female	275	185	110
9.	March 16, 1902, sex?	280	195	107

Of what Baur called *mobiliensis*, I have had one adult and several smaller specimens from Baker County, in Southwest Georgia, but while the adult has an arched shell and is a little larger (290 mm. long) than the largest I have measured from Raleigh, its shell is not more arched than those of some Raleign specimens, nor is the head larger than in some of them. In coloration it is identical with Raleigh specimens, as are also the young ones, except that none of them have any vertical yellow bars and concentrix markings on the marginals replaced by longitudinal yellow lines. I am inclined to consider this form as merely, at the most, a large southern form of *concinna*.

Of *floridana* I have had three good sized adults from Johnston County, N. C., and quite a number of small and half grown specimens from Southwestern Georgia, and Florida. These differ from *concinna* in usually having a vertical yellow

* See also "Some observations on the turtles of the genus Malademmys" by O. H. Hay, (Proc. U. S. N. M., Vol. XV, No. 908) in which he states that the females of this genus have larger heads than the males.

bar, forking at the upper end, down the center of the first and second costal plates, and in having the markings on the rest of the shell less concentric and usually in larger pattern. The marginal plates have a vertical yellow bar down the center of each, with concentric markings between; these latter, however, only occur in quite small specimens, as they disappear early in life leaving only the vertical bar. Head, legs, and plastron colored as in *concinna*. Ground color of carapace dark brown, darker than in *concinna*. The really important difference lies, however, in the shape of the shell, which is shorter and more arched than in *conciuna*, being in fact more nearly the shape of that of *P. scripta*, to which species *floridana* bears a superficial resemblance. The males have smaller heads and lower shells than the females.* The upper jaw is slightly, the lower jaw strongly, serrated, in all specimens that I have seen,

The measurements of the shells of some specimens are:

	Taken.	From.	Length.	Width.	Height.
1.	June 20, 1905,	Johnston Co., N. C.,	250	197	110
2.	June 30, 1905,	" " "	222	149	95
3.	June 30, 1905,	" " "	169	—	—
4.	May 14, 1904,	Baker Co., Ga.,	136	114	57
5.	July 20, 1904,	" "	150	—	—

I have seen no specimens of *labyrinthica* or *hieroglyphica* and the characters assigned to them by Dr. Baur (*loco cito*), are not of specific value, as they fall within the range of the individual variation of *concinna*. As *labyrinthica* is smaller than *concinna* and *mobiliensis* larger, it is quite possible it is a smaller† northern race of that species, just as *mobiliensis* appears to be a larger southern race.

* According to Dr. Baur (*loco cito*) *floridana* does not have serrated jaws, qut he places it in a section of the genus with lower jaw strongly serrated, so the absence of serrations probably applies only to the upper jaw, where they are little evident.

† *Labyrinthica* occurs in Tennessee and Illinois in the tributaries of the Mississippi.

Group III comprises three species which agree in having the upper jaw with a notch at the symphisis, but without cusps on each side of the notch, in the edges of both jaws being without serrations, in the ridge in the masticating surface of the jaws being non-tuberculate, and in the plastron being more or less blotched. These three are *scripta* of the Southeastern United States, and *elegans* and *troostii* of the Mississippi Valley and southwestward.

The three may be distinguished as follows:

1. Carapace keeled at all ages, a vertical yellow bar just behind eye. *Scripta.*

   Carapace not keeled in adult, no vertical yellow bar behind eye.

2. An elongate-oval red mark on neck behind eye. *Elegans.*

   No oval red mark on neck. *Troostii.*

Scripta is a large, heavily-built terrapin, with a wrinkled shell, and a distinct dorsal keel at all ages. A diagnostic mark of this species is a vertical yellow figure just behind the eye. The marginals are marked as usual in the genus with a vertical yellow bar and concentric figures between; the latter, however, are usually absent in adults. The carapace is marked on the costals with yellow, black and brown markings, there being usually a central yellow stripe down the middle of each costal with yellow and brown lines parallel to it and meeting their fellows above its upper end, and to some extent below its lower end; the black is more irregular in amount and position than the other colors, but there is always some black on each plate in the adult, although it is wanting in young specimens. On the posterior costals the markings are less regular and more confused. The plastron is yellow, or occasionally brownish, with a round black spot on each of the two anterior plates; often there is a black spot on the next two plates also, and occasionally one on every plate.

The largest specimen I have seen weighed seven and a half pounds and measured 272 mm.

Elegans is much like *scripta* in general appearance and in markings, but the shell is flatter and not keeled in the adult and the red neck spot is characteristic at all ages. The markings on the carapace are variable, but usually much as in *scripta*, but those of the plastron are different, each plate usually containing a black or dusky spot which is usually surrounded by one or more dusky concentric lines.

Of *troostii* I have only seen one specimen and that differed greatly in many respects from all the specimens of *scripta* and *elegans* that I have seen. It was from St. Louis, Mo., and measured 185 in length and 137 in breadth, and the tip of the nose extended 107 mm. beyond the front edge of the shell, when the neck was stretched to its fullest extent. The upper jaw was notched in front, lower jaw pointed at tip, neither serrated. Both upper and lower jaws much wider and more rounded than in any other *pseudemys* with which I am acquainted, especially than in *elegans* and *scripta*, which have the snout notably pointed. Head dark above with narrow, pale stripes; chin, throat, and neck below, light colored with rather pale darker stripes on neck below, much as in *Deirochelys reticulata*. Shell rather flat on top, rounded off on sides, rather deep, and much the shape of *Deirochelys*, but the bridge and shell not so high; shell smoother and without the wrinkles so characteristic of *Deirochelys*. Carapace dark brown with indistinct paler markings, most of the marginals with faint vertical bars which are barely visible. Plastron pale with some dark markings round the edges of the plates. Superficially and in length of neck this specimen resembles a *D. reticulata* more than it does the other species of *Pseudemys*, but I found on examination that the basal portion of the ribs was short, straight and broad as in other *Pseudemys*, not long, slender and arched as in *Deirochelys*.

SPECIMENS EXAMINED.

P. rubiventris, Orlando, Florida, one.

P. texana, Colmesneil, Texas, one; Shell Bank, La., one.

P. concinna, Raleigh, N. C., nine adults and several young.

P. mobiliensis (=*P. concinna*?), Mimsville, Ga., one adult, two young.

P. floridana, Johnson County, N. C., three adults; Orange County, Fla., two young; Mimsville, Ga., two half-grown specimens and several young.

P. scripta, numerous specimens from Raleigh, N. C., and Mimsville, Ga.; Lake Ellis, N. C., several.

P. elegans, Austin, Texas, three; St. Louis, Mo., three; Shell Bank, La., one.

P. troostii, St. Louis, Mo., one

THREE LITTLE KNOWN SPECIES OF NORTH CAROLINA FUNGI.

BY J. G. HALL.

It is my purpose to take up three species of fungi that are little known in North Carolina, and in fact in the United States, and to give a brief description of them.

The first two belong to the Hyphomycetes of Saccardo, but to different groups under this head. The third belongs to the Pyrenomycetes, and the family Sphaeriaceae.

The first I have preferred to call by the known name of Martensella pectinata, although as will be seen later, there are sufficient differences to make it a new species. It was first described by Coemaus in 1863 from Belgium.

This fungus is new to North Carolina, and in so far as I have been able to determine, has not been reported in print from the United States, although I know it to be in culture in one other place than West Raleigh.

The discovery of this species was partly an accident. Last December I was making some plate cultures from some soil that came from New Bern, in the eastern part of the State, for Sclerotinia, a lettuce disease upon which we have conducted a series of experiments.

In the culture I noticed growing a fungus that at first I took to be Botrytis, but upon microscopic examination found to be Martensella.

The fruiting hyphae stood erect and unbranched, except for the short spore bearing stalks, although later I found that the fungus became branched, and some times very much so.

The erect hyphae are septate and after arising a short distance above the substratum each cell sends out a short branch near the outer end. These short branches become the sporophores, and at first are indistinguishable from the main hypha except in size. Almost immediately the tips of the sporophores bend upward at approximately right angles and the portion beyond the bend rapidly becomes closely septate, having six to nine septae. The sporophores very soon become boat-shaped with the keel toward the main hypha. Upon the side away from the main hypha there arise small protuberances, the first appearing nearest the bend, and then being produced in succession toward the tip.

These growths early begin to show a slight swelling, forming a kind of head at the tip, which later lengthens into the fusiform spores; these are constricted into a very fine thread at the base, which connects them with a swollen base (basidia) that joins them to the naviculate sporophore.

Saccardo places this fungus in that group of the Hyphomycetes called the Mucedineae, because of the looseness and lightness of color of the mycelium. Also among the Amerosporeae of the latter, because of the shape and color of the spores.

In quoting the original description in his Sylloge Fungorum Saccardo says that the sterile hyphae are procumbent, with the fertile erect, with both branched and septate; the spores are borne on short lateral branches and in two rows along the face of the naviculate sporophore, being cylindric-fusiform in shape, and measuring 10-20x3 μ; that it is parasitic on Muco and the Saprolegneae. After giving the habitat a note is added saying that Cremans describes some of the spores as being borne in chains, and Engler & Prantl reproduce figures of the fungus which show some of the sporophores bearing catenulate spores, which are nearly globose in shape.

After the note Saccardo makes the very significant remark that the appearance of the catenulate spores is exceedingly strange.

Engler & Prantl also show the sporophores with the spore-bearing surface upward and inward.

In the early part of this note I said that I believed I would be justified in making a new species on account of the differences I found between my specimens and those in Saccardo and Engler & Prantl. I found: that the plant grew very freely with Penicillium as a host; that the spores are never borne in chains but always singly; that instead of being borne in two rows along the face of the sporophore, they are arranged all over its surface. In other respects my specimens agree with the descriptions noted.

The second species that we consider is one of the Genus Epicoccum, which belongs to the Tuberculariae, another group of the Hyphomycetes, so called because the mycelium forms a tubercle or mass of threads from which the spores arise.

The spores are borne in masses almost without sporophores, but what there is of them is light brown, although the greater part of the Mycelium is white. The spores are black when mature but brownish black in the younger stages. They are rough on the surface and look very much as if they were four-celled, but I have not been able to see any definite partitions. They are globose and measure from twenty to thirty μ in diameter.

In germination the spores send out short, almost globose cells, and after forming two or three of these at each point of germination, they grow into the regular septate hyphae, which continue to lengthen for some time.

Near the growing tip of the mycelium short branches arise, at first just a single filament, but very soon becoming much and irregularly branched, forming a hemispherical mass (sporodochium) upon the surface of which the spores are borne.

As an experiment this fungus was grown upon several different kinds of media to see if different nutrients had different effects upon it.

A medium which we called C. B. A., Chemical Base Agar, was made as follows: Water, 1000 grams; Di Potassium-phosphate, 2.5 grams; Calcium Chloride, 01 gram; Magnesium sulphate, 01 gram; Sodium Chloride, 2.5 gram; Potassium sulphate, 2 grams; Agar, 15 grams.

To this was added Sodium Aspariginate in one case; Sodium Aspariginate and Starch in another; Sodium Aspariginate and glucose in another, and one or two others. Four per cent. Pea Agar and Apple-twig Agar were also used.

On the Pea Agar the Mycelium was white with very few pink spots; upon the Apple and Apple-twig Agar the Mycelium was orange yellow with abundance of pink spots. Upon C. B. A. and N. A. S. and N. A. G. the Mycelium was white but with a large number of large pink spots. In all cases spores were formed in equal abundance and they were most numerous near the point of inoculation.

The third and last species belongs to a very different group of fungi, the Pyrenomycetes, which has its spores borne in sacs (asci) within closed or nearly closed conceptacles called perithecia. In giving the systematic position of this species, I shall follow Ellis & Everhart's North American Pyrenomycetes.

This is a new species of fungus, but I hesitate to give it a name because of the scarcity of material. It is one of the Genus Podospora, in the family Sordaieae, which is one of the sub-order Sphaerioceae.

The perithecia are borne singly and scattered, are black and flask-shaped. The asci are clavate and bear the eight spores which are the distinguishing feature of the plant. They are dark, elliptical, and are joined by a filament into pairs.

So far as I have been able to learn, there is only one species that approaches this in any way, and that is Podospora zygospora, in which the spores are similarly joined in pairs, but the thread joining each pair is septate, while in this one there are no septae in the connecting thread.